

Office Action Dated Sept. 8, 2004

Appl. No. 10/070,558  
Atty. Docket: 0459-0702P

#### REMARKS

Claims 39-70 are present in this application. Claims 1-34 have been canceled without prejudiced or disclaimer and claims 35-70 have been presented. Reconsideration of the Application, as amended, is respectfully requested.

An Information Disclosure Statement is being submitted. Notification of receipt of this Information Disclosure Statement as well as the consideration of the documents cited therein by the Examiner are respectfully requested.

Claims 8-11 stand objected to for a certain informality. By the foregoing amendments, the claims should overcome this objection. It is therefore respectfully requested that it now be reconsidered and withdrawn.

Claims 18, 32 and 33 stand rejected under 35 USC §112, second paragraph. This rejection is respectfully traversed.

Pending claims 55, 68 and 69 correspond to original claims 18, 32 and 33, respectively. The Applicants disagree with the objection raised by the Examiner because polysulfone is a family of polymers containing aromatic rings in a group-SO<sub>2</sub>-. Sulphonated polysulphone is a polysulphone with sulfonic acid group introduced into an aromatic ring. A chemist or a person skilled in the art would not confuse this and therefore the Applicants submit that the term "sulphonated polysulphone" is clear.

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Claim 53 which corresponds to original claim 16 should be clear by the amendments in this claim. Regarding original claim 22, this claim has been cancelled and is such the objection for an omnibus claim should be overcome. In view of the foregoing amendments, it is respectfully submitted that the claims particularly point out and distinctly claim the subject matter of the instant invention. Reconsideration and withdrawal of the 35 USC §112, second paragraph, rejection are respectfully requested.

Claims 1-17, 19, 20, 21, 23 and 24 stand rejected under 35 USC §103 as being unpatentable over Rosenmayer, German Document 19721952 in view of Hiroshi, EP 0869568. This rejection is respectfully traversed.

Claims 1, 6, 7, 12-15 and 19-24 stand rejected under 35 USC §103 as being unpatentable over Hiroshi in view of Hards et al., EP 0577291. This rejection is respectfully traversed.

Claims 1-5, 16, 25-29, 31, 32 and 34 stand rejected under 35 USC §103 as being unpatentable over Hiroshi in view of Hards et al. and further in view Onorato et al., WO 99/04445. This rejection is respectfully traversed.

Claims 17, 29 and 30 stand rejected under 35 USC §103 as being unpatentable over Onorato et al. in view of Sansone et al., U.S. Patent 5,599,639. This rejection is respectfully traversed.

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Turning to the Rosenmayer patent, a gas diffusion electrode is disclosed which comprises carbon black, thermoplastic polymer binder and particles of hydrophobous material. The electrode can be a foil of benzimidazole having soaked with  $H_3PO_4$  and subsequently attached to a catalyst/gas diffusion layer by pressing at room temperature. The electrode obtained is placed into a fuel cell testing device and operated at  $130^\circ C$  and 2 bar pressure above that of the atmosphere. The test device according to Rosenmayer has been doped with a weak acid (see Figure 1 - 1 M  $H_2SO_4$ ). The use of a weak acid also requires the pressure of a test device to become increased to 2 bar pressure above that of the atmosphere in order to run at  $130^\circ C$  without having the electrode to dry out and thus, losing the conducting effectively.

The electrode disclosed by Hiroshi et al. comprises a pliant gas diffusion layer comprising a specially designed carbon fiber woven cloth. This gas diffusion layer will also work as an electrode and has good diffusion properties in the surface direction, is mechanically pliant and resistant to compression, which ensures good electrical contact. The electrode provided by Hiroshi is doped with water which only allows the fuel cell to work at temperatures below  $100^\circ C$  in order to avoid drying out the electrode and losing the conducting effectively.

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Thus, neither Rosenmayer nor Hiroshi disclose, teach or motivate a person skilled in the art to believe that an electrode may be doped with a mixture of a volatile acid and a non-volatile acid for providing a fuel cell capable of running at temperatures up to at least 200°C without the risk of having electrode(s) to dry out and loose or reduce the conducting activity electrode.

It is therefore respectfully submitted that neither the Rosenmayer nor Hiroshi et al. references would suggest nor render obvious the subject matter of claims 35-54, 56-58, 59 or 60. In fact, these references would not suggest nor render obvious any of the pending claims of the present application.

Turning to the next rejection which utilizes the Hiroshi patent as a primary reference, the defect of the Hiroshi reference has been discussed above. Turning to the Hards et al. patent, this patent provides guidance for the fabrication of porous electrodes comprising (1) dispersed precious metal catalysts on carbon impregnated with proton conducting polymer and (2) dispersed carbon with hydrophobic polymer. Furthermore, the proton conducting polymer is a perfluorosulphonated ionomer and the hydrophobic polymer is polytetrafluoroethylene or ethylene-propylene copolymer. The preparation of the electrode according to the Hards et al. reference is completed by applying a coating of Nafion and subsequently dried. Nafion is not considered as being an acid because no H<sup>+</sup> ions are

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added into the solution. However, Nafion is a copolymer which is made electrically conductive by means of accepting free electrons by absorbing  $\text{OH}^-$  groups, e.g. from water, and leaves an excess of  $\text{H}^+$ . Thus, it is obvious that the electrode described by Hards is not doped with an acid because a competition for the  $\text{OH}^-$ -ions will arise. Therefore, it is common to dope electrodes comprising Nafion (such as the electrode mentioned by Hards) with water, which limits the use of the electrode to temperature of below  $100^\circ\text{C}$ .

Thus, neither Hiroshi nor Hards discloses, teaches or motivates a person skilled in the art to believe that an electrode may be doped with a mixture of a volatile acid and a non-volatile acid and hence, is capable of running at temperatures of up to at least  $200^\circ\text{C}$  without having the risk of having electrodes(s) to dry out and loose or reduce the conducting activity electrode. The technical effect conferring by doping the electrode with a mixture of a non-volatile acid and a volatile acid is to facilitate the wetting of the dopant solution on the surface of the electrode.

Thus, it is respectfully submitted that claims 35-60 are neither suggested nor rendered obvious by the Hiroshi et al. patent alone or in view of Hards.

The Hiroshi reference and the Hards reference have been discussed above. The Onorato et al. reference added in the rejection of paragraph 10 of the Office Action comprises polybenzimidazole

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(PBI) in the form of a paste or a gel containing 70-99.9% acid, preferably 99.9%. The paste or gel disclosed is not a solid phase, i.e. with little mechanical strength for fuel cell applications. Consequently, the paste or gel needs to be coated with a polymeric fabric or film in order to obtain a solid structure. Furthermore, by increasing the acid content or providing a very high acid content in the polymer membrane, e.g. 70-99.9%, the mechanical strength (tensile strength) of the electrode will decrease accordingly. Thus, the tensile strength of the electrode provided by Onorato et al. is very small (e.g. for one thing due to the high acid content).

None of the cited prior art documents discloses, teaches or suggests the use of a mixture of a volatile acid and a non-volatile acid in order to facilitate the wetting of the dopant solution on the surface of the electrode.

Therefore, it is respectfully submitted that claims 54 and 65 through 70 are neither suggested nor rendered obvious by this prior art combination.

In the rejection that begins on paragraph 10 on page 6 of the Office Action, it is respectfully submitted that neither Hiroshi, Hards or Onorato disclose, teach or motivate a person skilled in the art to believe in electrode doped with a mixture of a volatile acid and a non-volatile acid may be operated at temperatures up to 250°C without the need of continuously removal of CO in order to avoid

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poisoning the electrode. It is respectfully submitted that independent claim 61 is therefore neither suggested nor rendered obvious by the prior art utilized by the Examiner. In fact, all the claims which have been rejected by this prior art combination would neither be suggested nor rendered obvious by this utilized combination.

Finally, turning to the rejection which introduces the Sansone et al. patent, this proposed combination would not disclose, teach or motivate a person skilled in the art to combine polybenzimidazole and a thermoplastic resin. The technical effect conferred by this combination is to obtain an electrode having excellent mechanical properties and which therefore becomes less brittle. It is respectfully submitted that the claimed invention would neither be suggested nor rendered obvious by this prior art combination utilized by the Examiner.

It is respectfully submitted that the claims are non-obvious to a person skilled in the art in view of Rosenmayer, Hiroshi, Hards, Onorato and Sansone or any combination thereof. It is therefore respectfully requested that the prior art rejection now be reconsidered and withdrawn. Favorable reconsideration and an Early Notice of Allowance are earnestly solicited.

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In the event there are any outstanding matter remaining in this Application, the Examiner is invited to contact the undersigned at (703) 205-8000, in the Washington DC area.

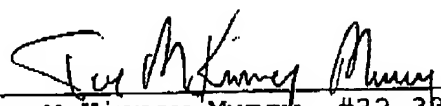
Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), the Applicant respectfully petitions for a one (1) month extension of time for filing a response in connection with the present application and the required fee of \$60.00 should be charged to Deposit Account No. 02-2448.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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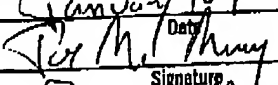
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